OIPE IAP53 SEP 06 2005 PATENT & TRADEMARK OFFICE

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

In re patent application of

Rappaport et al.

Serial No. 09/632,803 Group Art Unit 2123

Filed August 4, 2000 Examiner Phan

For SYSTEM AND METHOD FOR EFFICIENTLY VISUALIZING AND COMPARING COMMUNICATION NETWORK SYSTEM PERFORMANCE

Commissioner for Patents
PO Box 1450
Alexandria, Virginia 22313-1450

DECLARATION OF THEODORE S. RAPPAPORT
UNDER 37 C.F.R. §1.132

Theodore S. Rappaport declares as follows:

1. I am a recognized expert in the communications field with expertise in the design and analysis of communications systems which employ wireless communication technology. I hold the degree of PhD in Electrical Engineering, and I am currently a named Chair in Engineering at the University of Texas. A brief resume of some of my background and achievements is attached hereto.

I am a professor of electrical and computer engineering at The University of Texas at Austin, where I have been employed since the Summer 2002. From 1988 through 2002, I was a professor of electrical and computer engineering at Virginia Polytechnic Institute and State University. Thus, I have been an academic educator and researcher for over 17 years. I have also served as chairman and founder of two wireless communications companies, the most recent being Wireless Valley Communications, Inc. in Austin, Texas.

During my academic career, I have focused on research and education in the areas of telecommunications systems, wireless communications, radio wave propagation, digital signal processing, radio frequency (RF) hardware design,

communication system design and performance, and other areas related to the field of communications. I have authored, edited, coauthored, or coedited over 250 papers and technical reports, and over 18 books, in the area of wireless communications. One of the books that I have authored, "Wireless Communications: Principles and Practice", has been used as a textbook for senior level undergraduates and graduate student courses at dozens of universities throughout the world since 1996. Now in its 2nd edition, this book is translated in several languages.

During my career, I have advised over 70 research students in many areas of wireless communications, and have been a technical consultant for more than a dozen wireless communications companies. I have provided expert testimony to a sub-committee of the United States Congress in the area of Low Power FM, and have been qualified as a technical expert in patent trials in US District Court.

2. By virtue of my expertise, I am competent to provide testimony on the level of skill of one of ordinary skill in the art. It is my expert opinion that one of ordinary skill in the art would have a bachelors degree in Electrical Engineering, Computer Engineering, or Computer Science with some exposure to communications courses during their education. One of ordinary skill in the art would have 2-3 years of on-the-job experience in the wireless communications industry and would have worked on performance analysis software or algorithms, network or system design analysis or modeling, or test and measurement of wireless networks. Such a person of ordinary skill in the art would have been exposed, during their undergraduate coursework and/or during their on-the-job training to textbooks and materials as those taught in my book "Wireless Communications: Principles and Practice", and would have had exposure to wireless communications text books, test and measurement procedures, design and simulation software, and would also have computer programming experience including the ability to compile software. One of ordinary skill in the art would have been exposed to the concepts of predicting and modeling telecommunications network performance, since aspects of this concept are taught in virtually all undergraduate electrical engineering curricula and some, if not most, computer science curricula. In particular, the

concept of component performance attributes of a communications network is well known to upper level undergraduates, as course materials on noise figure, gain, bandwidth, and impedance matching are plentiful. Furthermore, well known and widely taught network performance parameters, and component or system performance attributes, that may be predicted or measured, such as signal-to-noise ratio, bit error rates, frame error rates, bandwidth, throughput, and in the case of antennas, antenna patterns, are all covered in junior and senior level communications courses at the undergraduate level. To be sure, the concept of free space path loss, which is a fundamental radio prediction performance model, is taught in virtually all undergraduate communication courses, and this is known as the Friis free space path loss model developed over seventy years ago. The Friis fress space model predicts received power as a function of distance, antenna gain, and frequency. Undergraduate textbooks such as Digital Communications by Bernard Sklar and Digital Communications by Leon Couch cover these concepts and force students to synthesize specific component attributes with prediction models to determine predicted performance parameters.

As a graduate researcher or working engineer, one of ordinary skill in the art would understand that the above concepts, taught in college, become more specialized and specific to different types of networks. Furthermore, the practitioner would understand that different and new performance metrics could be used. That is to say, experience would help sharpen the practitioner's understanding that, in order to characterize or predict performance of a communications system, a GSM network requires different performance metrics, measurement techniques, and analysis techniques than does a CDMA network, for example. Further, specific differences arise when comparing WLAN networks with cellular networks, etc. Yet, the practitioner would appreciate and have a firm understanding that for each of these types of networks, fundamental knowledge of the performance attributes of specific system components (the gain, noise figure, bandwidth, frequency of operation, etc. of base stations, access points, amplifiers, repeaters, cabling, antennas, filters, etc., and antenna patterns for antennas) and basic measurement techniques and prediction techniques, would be useful and in fact necessary to solve engineering problems related to the specific technology.

Furthermore, the practitioner of ordinary skill in the art would have a sound understanding that the radio propagation characteristics of a wireless network, and the type of antennas used in such a network, would have an impact on the predicted or measured performance. These concepts are taught in various chapters throughout my textbook "Wireless Communications: Principles and Practice" for example, and define the typical performance attributes ascribed to different components of a wireless network, typical path loss propagation models used in the wireless industry, and types of performance measurements that are made in the wireless industry. The practitioner of ordinary skill would be exposed to many sorts of hardware, software, and textbooks regarding these topics.

3. I am a joint inventor on the above-identified patent application, and I have read and understand the above-identified patent application. Briefly described, the invention disclosed therein relates to a computer software product for designing, optimizing, managing and maintaining a communication network. For exemplary purposes Figure 13 of the application shows differences in predicted values, differences between predicted and actual measured values, and differences between measured values of one or more performance metrics can be displayed in a site specific manner. Figure 13 graphically shows, in an iconic format, differences that may arise between a predicted value and a measured value which may be due to the impact of certain technologies or attributes of certain objects that are not accounted for in the prediction engine. The specification teaches that other methods for displaying such differences could be used (e.g., pyramids, cones cubes, shaded colors, watchpoints, grids of vertices, or other three dimensional graphical entities, etc.). This presentation could also show differences between measured data at the same location at two different time periods - it being understood that differences could arise due to interference from a newly installed neighboring system. The present invention could also show differences between two predicted values, for example, using different prediction engines or prediction models-it being understood by one of ordinary skill in the art, for example, that different models put different weighting on different factors, and differences may also result from having two or more radiated signals being received or modeled at

a particular point, etc.

4. I have read and understand the Office Action mailed March 10, 2005. I also attended an interview with the newly assigned Examiner to the above-identified patent application at the USPTO on September 2, 2005. In the office action of the previous Examiner dated March 10, 2005, claims 1-55 were rejected under 35 U.S.C. 112, first paragraph, for

"containing subject matter which was not described in the specification in such a way as to reasonably convey to one of ordinary skill in the relevant art that the inventor, at the time the application was filed, had possession of the claimed invention".

The Examiner erroneously reasoned that each independent claim includes the limitation "one or more prediction models which use the computerized model and the performance attributes of specific components of said plurality of system components to predict performance characteristics of said communications network", and that "the Specification appears to describe the importance of providing input data to the SitePlanner® prediction engine, the Specification does not appear to disclose how one skilled in the are would make and use the prediction models" (emphasis added). From these comments, it appears that the Examiner is under the mis-impression that one of ordinary skill in the art would not be familiar with how prediction models would be produced and used.

5. In my expert opinion, the position of the previous Examiner taken in the office action of March 10, 2005 is simply in error. In my expert opinion, one of ordinary skill in the art, having read the patent application, would clearly see and understand the invention and know how to make and use it. That is, contrary to the Examiner's conclusion, at the time the application was filed, the subject matter was described in the specification in such a way that it reasonably conveyed to one of ordinary skill in the relevant art that the inventor had possession of the claimed invention. In short, it is my expert opinion that the invention is fully enabled within the meaning of 35 U.S.C. 112, first paragraph.

6. It is also my expert opinion, that no "essential material" was left out of the application, and that one of ordinary in the art at the time the application was filed would be able to make and use the invention without reference to subject matter in other patents of mine identified by the Examiner (including 6,317,599; 6,442,507; 6,493,679; and 6,499,006). As will be discussed in more detail below, prediction models were well recognized by those of skill in the art at the time the invention was made. They are described in basic textbooks, journal articles, and the like and were, at the time the invention was made, covered during undergraduate education by one who would enter the field of the invention, and be used regularly by those who work in the field of the invention. Thus, the conclusion of a dependency on any particular prediction engine is simply incorrect (it being understood that the claims are not limited to a particular prediction engine), and the reasoning that one of ordinary skill in the art would not know or understand these well defined tools is simply in error. This was acknowledged during the interview with the newly assigned Examiner, as we discussed during the interview with references to pages and drawings in the basic and polular textbook I authored: Wireless Communications: Principles & Practice (Prentice Hall 1996 (published prior to the application being filed), and 2002). Second, pages 3 and 4 of the patent application and the references in the information disclosure statements filed in the present application identify a number of references that would have been available to and consulted by one of ordinary skill in the art at the time the invention was made, and the existence of these articles, which are already of record in the present application, demonstrate unequivically that there is no requirement for any particular prediction engine (as erroneously concluded by the prior Examiner) and that prediction engines were well understood and recognized tools used by those of skill in the relevant art at the time the present application was filed in the USPTO.

7. Attached is a claim chart showing passages in the specification and identifying certain drawing figures which one of ordinary skill in the art would be able to read and understand, and would be able to then use as guide to make and use the claimed invention.

To implement the software, the practitioner would need to have a command of graphical user interface programming or would need to rely on a third party software platform that allows for various databases to be accessed. Also, the practitioner would need to implement a display of the physical environment that interacts with components, parts lists, etc. This would require the ability to link and display, and to format various data sets for proper storage and programming control. It will be well recognized that the use of pull down menus or mouse movements or other input positioning devices are well developed tools that are readily implemented in software by one of ordinary skill in the art.

To implement the invention, the practitioner of ordinary skill in the art would need to be able to write or use software to read in, obtain, or create their own computerized model of a physical environment. This could be accomplished by using any one of a number of computer aided design packages, such as AutoCAD or Bently MicroStation, or by writing software that could manipulate, edit, augment, or emulate image files, such as .TIF or .GIF or other formats, that represent and display at least a portion of a physical environment. The time required to do this would depend very much on the details of the implementation, ranging from 40 hours to simply import and process particular formats, to 300 to 500 hours for a sophisticated, multifaceted software implementation that could process many types of formats and provide a computerized model of the physical environment using a myriad of "starting points".

The practitioner of ordinary skill in the art would need to be able to represent performance attributes (e.g. product specifications, or spec. sheets) for a number of system components of a wireless network in the software. This could be done using spread sheets, or by obtaining catalogs of components from the world wide web, and then allowing this data to be used in the software for predicting or modeling performance. The concept of a database of parts and their specifications are well known, and have been used for years by companies such as Andrew Corporation and CommScope to sell coaxial cable, antennas, and other equipment needed in wireless communications systems. The time required to implement a database of parts lists would be entirely dependent upon the form of the database, and the flexibility and transportability of the data, but would range

from a minute or two (simply finding and using an already existing database from a particular equipment supplier) to many hours if a custom database format were used in the software.

To implement prediction models that use the computerized model and the specific attributes of particular components of the network, one of ordinary skill in the art would know that the software needs to be able to read and store parameter values from the parts list database, process them in light of the interaction of the radio wave propagation models with the environment. All of these techniques would have been understood by one of ordinary skill in the art at the time the invention was made as taught in my textbook "Wireless Communications: Principles and Practice", or numerous papers cited on pages 3 or 4 of the application or in the documents in the information disclosure statement, and the implementation in software would require standard bookkeeping and use of pointers in memory. Memory management and parameter passing techniques would be used. Practitioners of ordinary skill in the art with experience writing software would have experience and knowledge of how to properly manage the various interdependencies needed.

8. I hereby declare that all statements made herein of my own knowledge are true and that all statements made on information and belief are believed to be true; and further that these statements were made with the knowledge that willful false statements and the like so made are punishable by fine or imprisonment, or both, under 18 U.S.C. 1001 and that such willful false statements may jeopardize the validity of the application or any patent issued thereon.

Theodore S. Rappaport

Sept 03, 2005
Date

OIPE IAP53
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Theodore S. Rappaport
(Fellow IEEE)
(S'83-M'84-S'85-M'87-SM'90-F'98)
Revised 05/05

Theodore S. Rappaport is an active teacher, researcher, and entrepreneur. He received BSEE, MSEE, and Ph.D. degrees from Purdue University in 1982, 1984, and 1987, respectively. From 1988 to 2002, he was on the faculty of Virginia Tech. He joined the University of Texas in 2002 as the William and Bettye Nowlin Chair in Engineering, and is the founding director of the Wireless Networking and Communications Group (WNCG) at UT's Austin campus. He has over 100 US or international patents issued or pending and has authored, co-authored, and co-edited numerous books in the wireless field, including the popular textbooks *Wireless Communications: Principles & Practice* (Prentice-Hall, 1996, 2002), *Smart Antennas for Wireless Communications: IS-95 and Third Generation CDMA Applications* (Prentice Hall, 1999), and *Principles of Communication Systems Simulation* (Prentice Hall, 2004). He was recipient of the 1999 Stephen O. Rice Prize Paper Award from the IEEE Communications Society.

Dr. Rappaport currently serves on the Technological Advisory Council for the Federal Communications Commission, and has served on National Academy of Science panels pertaining to telecommunications research in the US. He also served as Technical Program Chairman for the IEEE Global Communications Conference in 2004. He is series editor for the Prentice Hall Communications Engineering and Emerging Technologies book series, and serves on the editorial board of International Journal of Wireless Information Networks (Plenum Press, NY) and the advisory board of Wireless Communications and Mobile Computing for Wiley InterScience. He is a Fellow of the IEEE, and is active in the IEEE Communications and Vehicular Technology societies.

In 1989, Rappaport founded TSR Technologies, Inc., a cellular radio/PCS software radio equipment firm that he sold in 1993, and in 1995, he founded Wireless Valley Communications, Inc., a pioneering creator of software products for the design, measurement, and management of wireless networks. He is a registered professional engineer in the states of Virginia and Texas, and is a Fellow and past member of the board of directors of the Radio Club of America. He has consulted for over 25 multinational corporations and has served the International Telecommunications Union as a communications consultant for emerging nations.

Rappaport received the Marconi Young Scientist Award in 1990, an NSF Presidential Faculty Fellowship in 1992, the Sarnoff Citation from the Radio Club of America in 2000. He received the James R. Evans Avant Garde award from the IEEE Vehicular Technology Society in 2002, the Frederick Emmons Terman Outstanding Electrical Engineering Educator Award from the ASEE in 2002, and the Outstanding Electrical and Computer Engineering Alumni Award from Purdue University in October 2004. Ted is married and has three children.

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Abstract
A method for visualizing and efficiently making comparisons of communication system performance utilizing predicted performance, measured performance, or other performance data sets is described. A system permits visualizing the comparisons of system performance data in three-dimensions using fluctuating elevation, shape, and/or color within a three-dimensional computer drawing database consisting of one or more multi-level buildings, terrain, flora, and additional static and dynamic obstacles (e.g., automobiles, people, filing cabinets, etc.). The method enables a design engineer to visually compare the performance of wireless communication systems as a three-dimensional region of fluctuating elevation, color, or other aesthetic characteristics with fully selectable display parameters, overlaid with the three-dimensional site-specific computer model for which the design was carried out.

Claim 33

A method for designing, managing, optimizing or maintaining a communications network or communications networks, comprising the steps of: providing	The patent application describes methods for a user to design, manage, optimize, and maintain a plurality of communication networks. -- *"According to the present invention, a system is provided for allowing a RF system designer or a communication network designer to dynamically model a wired or wireless system electronically in any environment."* – Page 13, lines 8 - 11
(A) a computerized model which represents a physical environment in which a communications network may be installed, said computerized model providing a display of at least a portion of said physical environment,	The patent application describes methods for representing and displaying a computerized model of a physical environment. This is described in detail within: -- Page 14, lines 20 – 29 -- Page 23, lines 16 – 30 -- Page 26, lines 6 – 13 -- Page 26, line 21 through page 27, line 9 -- Page 28, lines 5 – 19 -- Page 34, line 30 through page 35, line 10 -- Figures 2 and 3, which are screenshots from the invention

(B) performance attributes for a plurality of system components which may be used in said physical environment,	The references provided by the information disclosure statement show that it was well recognized by those of skill in the art that components would have a variety of performance attributes (spec sheets used for advertising or selling these components show these attributes). Furthermore, the present application discusses performance attributes for a plurality of system components, each of which may be used within the physical environment. See: -- Page 24, line 16 through page 17, line 6 -- Page 34, line 5 through page 35, line 10
(C) one or more prediction models which use the computerized model and the performance attributes of specific components of said plurality of system components to predict performance characteristics of said communications network,	Pages 3 and 4 of the patent application, as well as the references filed in the information disclosure statement filings demonstrate that it was well known to one of ordinary skill in the art at the time the invention was made that prediction models for wireless performance characteristics were well understood, as was their using in computer based computations. Furthermore, the patent application provides multiple prediction models that utilize the computerized model of the physical environment as well as the performance parameters of specific components in order to accurately represent the performance characteristics of the communications network. See: -- Page 15, lines 8 – 21 -- Page 25, lines 7 – 22 -- Page 34, line 5 through page 35, line 10 -- Page 38, lines 12 – 19

(D) actual performance measurements taken from said physical environment at one or more locations during one or more measurement runs;	Collection of performance metrics was well understood by those of ordinary skill in the art at the time the invention was made, as is evidenced by many of the references submitted by information disclosure statement. The patent application discusses allowing for the collection, storage, and display of measurement data runs. See: -- Page 15, line 12 through page 16, line 16 -- Page 28, line 25 through page 30, line 24
Selecting specific components from said plurality of system components for use in said communications network; and	The patent application describes the selection and placement of components for use in said communications network. See: -- Page 13, line 8 through page 14, line 19 *"The method includes the selection and placement of models of various wireless or optical or baseband communication system hardware components..."* – Page 13, lines 11 – 13 *"Using a mouse or other input positioning device the designer may select and view various communication hardware device models that represent actual communication system components from a series of pull-down menus. A variety of amplifiers, cables, connectors, and other hardware devices described above which make up any wired or wireless communication system or network may be selected, positioned, and interconnected in a similar fashion by the designer to form representations of complete wireless or wired communication systems."* – Page 14, line 30 through page 15, line 7 *"Once the 3-D environmental database has been constructed, the designer identifies and specifies the location and type of all wireless communication system equipment within the 3-D*

	environmental. This point-and-click process involves the user selecting the desired hardware component from a computer parts database and then visually positioning, orienting, and interconnecting various hardware components within the 3-D environmental database to form complete wireless communication systems." – Page 24, lines 16 – 23
displaying a computer representation of said physical environment using said computerized model, said computer representation showing locations of specific components selected in said selecting step within said physical environment and performance information for one or more locations within said physical environment, said performance information being any one or more of the following:	Display technology was well developed at the time the invention was made, as is evidenced by many of the articles submitted with the information disclosure statements. The patent application describes a method to display a computerized model of the physical environment with locations of specific components and performance information shown. -- Page 13, line 8 through page 14, line 19 -- Page 15, line 12 through page 16, line 16 -- Page 19, line 8 through page 20, line 2 -- Page 25, line 13 through page 26, line 13 -- Page 28, lines 5 – 19 -- Page 36, lines 9 – 29 -- Figures 6 through 9 -- Pages 38-41 -- Figures 13 and 14
(A) showing a comparison of actual performance measurements to predicted performance values,	The patent application describes methods to display a comparison between predicted and measured performance values. See: -- Page 15, line 12 through page 16, line 16 -- Page 16, line 27 through page 18, line 20 -- Page 25, line 13 through page 26, line 13 -- Page 28, lines 5 – 19

	-- Page 36, line 22 through page 37, line 15 -- Pages 38-41 -- Figures 13 and 14 (note particularly the cylinders in Figure 13)
(B) showing a comparison of actual measurements taken during two or more measurement runs, and	The patent application describes a method to display a comparison between two or more measured performance values. See: -- Page 15, line 12 through page 16, line 16 -- Page 16, line 27 through page 18, line 20 -- Page 25, line 13 through page 26, line 13 -- Page 28, line 25 through page 30, line 24 -- Pages 38-41 -- Figures 13 and 14 (note particularly the cylinders in Figure 13)
(C) showing a comparison of at least two different predictions made with at least two different simulations.	The patent application describes a method to display a comparison between two or more predicted performance values. See: -- Page 15, line 12 through page 16, line 16 -- Page 16, line 27 through page 18, line 20 -- Page 25, line 13 through page 26, line 13 -- Page 28, lines 5 – 19 -- Page 36, line 21 through page 37, line 15 -- Pages 38-41 -- Figures 13 and 14 (note particularly the cylinders in Figure 13)